AN AIRBORNE EVALUATING EQUIPMENT STUDY

PRC D-1303

Quarterly Progress Report

9 May - 8 August 1966

Contract NAS 8-20367

12 August 1966

PLANNING RESEARCH CORPORATION

LOS ANGELES, CALIF. WASHINGTON, D.C.

This report was prepared by Planning Research Corporation under Contract No. NAS 8-20367, "An Airborne Evaluating Equipment Study," for the George C. Marshall Space Flight Center of the National Aeronautics and Space Administration. The work was administered under the technical direction of Quality and Reliability Assurance Laboratory, George C. Marshall Space Flight Center with Joseph Mitchell acting as project manager.

PROGRESS DURING REPORTING PERIOD

Work during the reporting period was centered in five major areas:

System Implications of Boeing AEE Concept

The primary effort of the quarter was the determination of the system implications of applying the Boeing AEE concept to the Apollo Applications Program. This involved careful examinations of the problems of integrating the Boeing AEE concept into current factory, static firing and pre-launch checkout operations, and of its operations in earth orbit. Some of the problem areas addressed included: operating concepts of operational and support software during checkout operations, software/software interfaces, interaction of ground and on-board equipments during test operations, modifications required in ground computer software, and new software required to implement. Additional work focused on the ability of the Boeing concept to supply necessary control and displays for ground personnel.

Results of this investigation were presented to MSFC personnel. Generally, it was found that the Boeing concept could be implemented, but at a high cost in changes to ground system software and operational procedures. It was found that to implement the Boeing concept would require extensive modification to the operating systems (software) for both the LCC at KSC and the IU checkout at IBM-Huntsville. In fact, it would probably prove more efficient to redo the entire LCC software system than add the AEE operations as an extension to the current system. Other problems found were the loss of the LVDC control for experiment checkout once the IU and LEM were separated, inability of the Boeing concept to perform the on-board data management role and the operational difficulties imposed on the ground complex due to the interwoven series of both Apollo and AAP vehicles. If the AAP vehicles had the AEE and the Apollo vehicles did not, then the complexity of ground operations would be severely increased, especially in areas of software configuration management and operations with modified vehicles.

Alternate AEE Hardware Approaches

During the first week of the study it was determined, jointly with the MSFC project manager, that the intent of the study could not be satisfied without further definition of alternate hardware approaches to AEE/OCS. A contract modification was initiated and work was begun to determine, at the conceptual design level, on-board checkout systems employing digital computer control. Centralized and decentralized computer systems and alternate means of data acquisition were primary factors of design approaches to alternate systems.

Initially, the intended application of the alternate OCS configuration was factory, static firing, pre-launch and on-orbit checkout of the S-IV B and IU stages, and integration, pre-launch and orbital checkout and orbital data management of AAP experiments carried in these stages.

Following the presentation of the analysis of Boeing's concept, it was determined, jointly with the MSFC project manager, that many of the problems that would be created by integrating the Boeing concept into current ground system operations, on a minimal interference basis, would hold for the computer-controlled OCS systems as well. Technical direction was received from the MSFC project manager to reorient the focus for application of OCS. Rather than attempting to integrate OCS into current ground operations for the S-IV B and IU and designing the OCS for orbital operations on these stages, the primary initial focus for application is to be the AAP experiments carried in the LEM. Follow-on applications would extend OCS to the S-IV B and IU.

Subsequent to the technical direction noted in the preceeding paragraph, conceptual design efforts were reoriented to designing an OCS that will provide in-space data management, and integration, pre-launch and in-space checkout of AAP experiments in the LEM, as an immediate objective. This system will ultimately become part of a total Saturn-Apollo OCS; hence, the total Saturn-Apollo OCS is being conceptually designed simultaneously with this primary focus on detailed definition of the LEM-carried OCS equipment. This will assure system-optimized computer and test equipment configurations for the LEM-carried OCS and ultimate effective growth to a total vehicle OCS.

Partial results of this task have been reported in D-1237, "A Survey of Spaceborne Computers", a survey and analysis of computers potentially suitable for OCS application.

Software System for Alternate OCS Configurations

A companion study to the definition of alternate hardware configurations, this task is defining the software system for use with a computer-controlled OCS. Still in its early stages, work is currently underway to define the OCS software, including OCS operating programs, support programs and test planning language, and the software required for operations with OCS using the S-1C checkout system at MSFC, the ACE system at KSC and GOSS during space flight. Requirements for orbital checkout of S-IV B and IU stages and carried experiments are also being determined, but in a secondary manner, so that the OCS software system can be designed for ease of growth to a total Saturn-Apollo vehicle system.

Test Information Flow

Initial work on this task documented (partially) the current information flow from test engineer to operating programs for the S-IV B and IU. The types and quantities of information flow were described. Then, the modifications to this flow to best accommodate the Boeing concept were determined. In particular, the potential use of a test language and compiler that simultaneously prepares programs for AEE tapes and instructions for ground checkout system programming, was investigated. This possible modification to the test information flow was reported as part of the analysis of Boeing's concept.

Test Context Definition

This task, support to the previous four, was directed primarily to filling the gaps in knowledge concerning such contextual factors as: maintenance plan, sensor and measurement techniques, roles of test personnel and their information and control requirements, and test documentation and information flow. To accomplish this task much documentation was acquired and visits were made to checkout facilities at Douglas-Huntington Beach, Douglas-Sacramento, IBM-Huntsville, and NASA-KSC.

ANTICIPATED WORK

Work during the forthcoming reporting period will include:

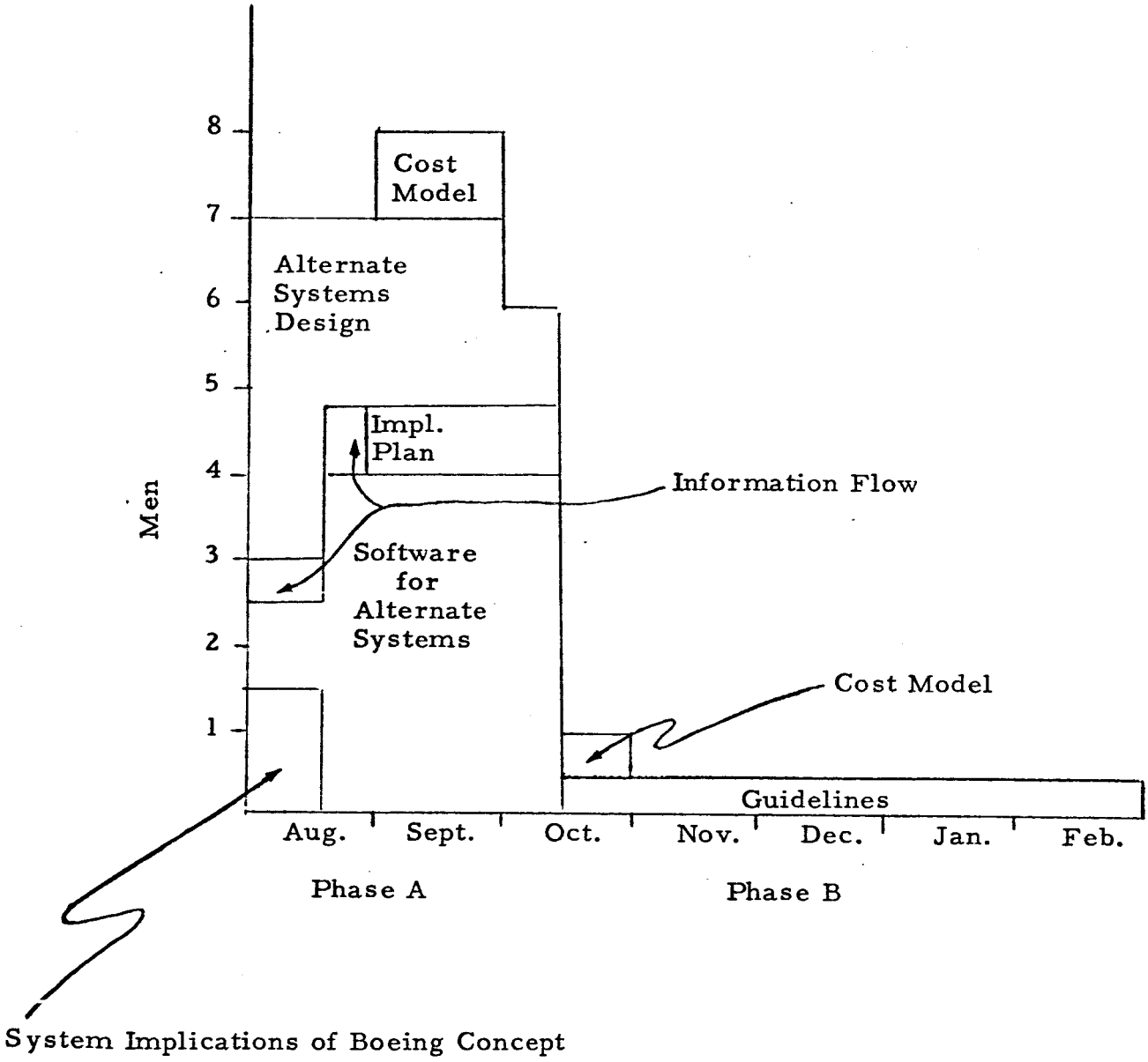
1. Completion and submittal of written report on system implications of Boeing concept.
2. Completion of conceptual designs of alternate OCS configurations.
3. Continuation of system software definition for computer-controlled OCS configurations.
4. Determination of preferred information flow for AAP experiment checkout using OCS.
5. Initiation of study to determine an effective implementation plan for OCS.
6. Initiation of work to determine total system cost implications of a computer-controlled OCS for AAP experiments on LEM.

PROBLEM AREAS

Throughout the quarter, the major problem has been the acquisition of meaningful test requirements for AAP experiments. Results of several NASA-sponsored studies dealing with AAP experiments have been acquired. None of these give explicit data on likely test points, signals or techniques. As these reports represent the best available information on the subject, however, they are being used, and supplemented by general test knowledge to define requirements on the design of the OCS.

PROGRAM PLANNING CHART

The current program plan is as follows. It represents the latest technical redirection. Only technical manning is shown.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